



UL 4740

STANDARD FOR SAFETY

Lidar and Lidar Systems Used in Vehicles

UL Standard for Safety for Lidar and Lidar Systems Used in Vehicles, UL 4740

First Edition, Dated September 19, 2024

Summary of Topics

This is the First Edition ANSI/UL 4740, Standard for Lidar and Lidar Systems Used in Vehicles dated September 19, 2024.

The new requirements are substantially in accordance with Proposal(s) on this subject dated July 19, 2024.

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UL 4740

Standard for Lidar and Lidar Systems Used in Vehicles

First Edition

September 19, 2024

This ANSI/UL Standard for Safety consists of the First Edition.

The most recent designation of ANSI/UL 4740 as an American National Standard (ANSI) occurred on September 19, 2024. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

Comments or proposals for revisions on any part of the Standard may be submitted to ULSE at any time. Proposals should be submitted via a Proposal Request in the Collaborative Standards Development System (CSDS) at <https://csds.ul.com>.

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1 Scope

This Standard covers vehicle lidar and lidar systems rated 12 Vdc and 24 Vdc. The lidar and lidar systems' ability to safely withstand simulated abuse conditions will be evaluated based upon the manufacturer's specified parameters of use. The non-safety performance of these devices will not be evaluated.

This Standard includes requirements for the evaluation of lidar and lidar systems concerning mechanical safety, electrical safety, optical radiation safety, cybersecurity, and functional safety.

This Standard does not cover host equipment or actions or operations of a host equipment platform employing lidar or lidar systems.

NOTE: Lidar and lidar systems of other voltages will be considered in the future.

2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

FDA/CDRH *Code of Federal Regulations 21 CFR, Part 1040*

IEC 60529, *Degrees of protection provided by enclosure (IP Code)*

IEC 60825-1, *Safety of laser products – Part 1: Equipment classification and requirements*

IEC 60825-2, *Safety of laser products – Part 2: Safety of optical fibre communication systems (OFCs)*

IEC 62471:2006, *Photobiological safety of lamps and systems*

ISO 6722-1, *Road Vehicles – 60 V and 600 V singlecore cables – Part 1: Dimensions, test methods and requirements for copper conductor cables*

ISO 7000, *Graphic symbols for use on equipment – Registered symbols*

ISO 7637-2, *Road vehicles – Electrical disturbances from conduction and coupling – Part 2: Electrical transient conduction along supply lines only*

ISO 16750-2, *Road vehicles – Environmental conditions and testing for electrical and electronic equipment – Part 2: Electrical loads*

ISO 16750-3, *Road vehicles – Environmental conditions and testing for electrical and electronic equipment – Part 3: Mechanical loads*

ISO 16750-4, *Road vehicles - Environmental conditions and testing for electrical and electronic equipment – Part 4: Climatic loads*

ISO 21448, *Road vehicles – Safety of the intended functionality*

ISO 26262, *Road vehicles – Functional safety (All Parts)*

SAE J1127, *Low Voltage Battery Cable*

SAE J1128, *Low Voltage Primary Cable*

SAE USCAR 2, *Performance Specification for Automotive Electrical Connector Systems*

UL 13, *Power-Limited Circuit Cables*

UL 444, *Communication Cables*

UL 1581, *Electrical Wires, Cables, and Flexible Cords*

UL 2556, *Wire and Cable Test Methods*

UL 62368-1, *Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements*

3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

– IEC Electropedia: available at <http://www.electropedia.org/>

– ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 Abbreviations

Abbreviations are summarized alphabetically in [Table 1](#).

Table 1
Abbreviations

ASIL	Automotive Safety Integrity Level
CDRH	Center for Devices and Radiological Health
FDA	Food and Drug Administration
FOV	Field of View
HARA	Hazard Analysis and Risk Assessment
IP	Ingress Protection
LED	Light-Emitting Diode
NEMA	National Electrical Manufacturers Association
PSD	Power Spectral Density
SEooC	Safety Element out of Context
SOTIF	Safety of the Intended Functionality
UV	Ultraviolet

3.2 Terms

3.2.1

automotive safety integrity level (ASIL)

One of four levels to specify the item's or element's necessary ISO 26262 requirements and safety measures to apply for avoiding an unreasonable risk, with "D" representing the most stringent and "A" the least stringent level.

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3.2.2

belt line

The imaginary line on a vehicle body below the windows.

3.2.3

element

System, components (hardware or software), hardware parts, or software units.

NOTE: There are intentional overlaps in the definitions of item, element, and SeooC; an element is an item if it fully implements a known function at the vehicle level, an element of an item implements part of a known function at the vehicle level, or an element is a SEooC if the item in which the element will be used is not known.

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3.2.4

exterior of a vehicle

All areas of a vehicle that are not the interior of a vehicle.

3.2.5

functional status

The status of a device under test's functionality after preconditioning or testing with respect to its unconditioned, untested intended functional specifications.

3.2.6

hazard analysis and risk assessment (HARA)

Method to identify and categorize hazardous events of items and to specify safety goals and ASIL related to the prevention or mitigation of the associated hazards in order to avoid unreasonable risk.

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3.2.7

human access

The capacity to intercept laser and/or incoherent broadband radiation by any part of the human body. For laser products that contain Class 3B or 4 levels of laser radiation, 'human access' also means access to laser radiation that can be reflected directly by any single introduced flat surface from the interior of the product through any opening in the protective housing of the product.

3.2.8

ingress protection (IP)

Protection of an enclosure against the ingress of solid objects or water.

3.2.9

interconnecting wire and cable

Wire and cable outside of a lidar or lidar system enclosure.

3.2.10

interior of a vehicle

The passenger or operator's cabin, or storage compartments for baggage.

3.2.11

item

System, or combination of systems, to which ISO 26262 is applied, that implements a function or part of the function at the vehicle level.

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3.2.12

lidar

A sensor using light detection and ranging technology.

3.2.13

lidar system

A system of multiple elements that includes one or more lidar, interconnecting electrical or optical cables and one or more central or distributed data processing units providing sensing data to the host vehicle.

3.2.14

point cloud

A locus of data points in 3D space.

3.2.15

pollution degree

Numerical characterizing the expected pollution of the micro-environment.

3.2.16

safe state

Operating mode, in case of a failure, of an item without an unreasonable level of risk.

3.2.17

safety element out of context (SEooC)

Safety-related element which is not developed in the context of a specific item.

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3.2.18

safety goal

Top-level safety requirement as a result of the HARA assessment at the vehicle level.

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3.2.19

sprung mass

The portion of a vehicle that is supported by a vehicle's suspension (springs and shock absorbing components).